

WHAT IS CLAIMED IS:

1. A print position adjusting method for a printing apparatus, wherein the printing apparatus uses a print
5 head having an array of a plurality of print elements and forms an image on a print medium by scanning said print head in a direction different from an arranging direction of the plurality of print elements and wherein rasters making up the image are divided into
10 at least two raster groups according to a driving mode of the plurality of print elements, said method for adjusting print positions by the plurality of print elements between the at least two raster groups, said method comprising the steps of:

15 forming a plurality of adjustment patterns by said print head, in a manner that a print element drive timing between the at least two raster groups is shifted a predetermined interval, said print element drive timing being a timing of driving the plurality
20 of print elements;

entering an adjustment value for the print element drive timing between the at least two raster groups, the adjustment value being determined from the plurality of adjustment patterns; and

25 storing the entered adjustment value.

2. A print position adjusting method as claimed in

claim 1, wherein said print head has at least two columns of print elements arranged side by side in the scan direction, the at least two columns of print elements are shifted from each other by an amount less than a pitch at which the print elements are arranged in the column, and the at least two columns of print elements print the at least two raster groups.

3. A print position adjusting method as claimed in claim 2, wherein said print head has a nonvolatile memory in which unique information on said print head is stored, the nonvolatile memory stores at least the adjustment value for adjusting the print positions, and said adjustment pattern forming step shifts the drive timing between the at least two columns of print elements by the predetermined interval by taking the adjustment value stored in the nonvolatile memory as a reference to form the plurality of adjustment patterns.

4. A print position adjusting method as claimed in claim 1, wherein the printing apparatus scans said print head with respect to said print medium in a forward direction and in a backward direction and feeds the print medium relative to the print head in a direction perpendicular to the scan direction by a distance required to print an image on said print medium at a density higher than that in which the

plurality of print elements are arrayed, the relative feeding of the print medium being performed between the forward scan and the backward scan, the forward scan and the backward scan being performed to print
5 the two raster groups.

5. A print position adjusting method as claimed in claim 1, wherein the adjustment patterns have a dot distribution with a blue noise characteristic at a
10 resolution at which the printing apparatus can print.

6. A print position adjusting method as claimed in claim 1, wherein the adjustment patterns are digitized by a conditional decision making method of a dithering
15 method at a resolution at which the printing apparatus can print.

7. A print position adjusting method as claimed in claim 1, wherein said print head ejects ink to perform
20 printing and the print elements have a nozzle for ejecting the ink.

8. A print position adjusting method as claimed in claim 7, wherein said printing apparatus can set a
25 speed of the scan and a distance from the nozzles to the print medium in at least two stages respectively and has a step of correcting the adjustment value

according to a combination of the scan speed and the distance.

9. A print position adjusting method as claimed in
5 claim 7, wherein the print head has heating elements to generate thermal energy for causing film boiling in ink as an energy for ejecting ink from the nozzles.

10. A print position adjusting method for a printing
10 apparatus, wherein the printing apparatus uses a print head having an array of a plurality of nozzles for ejecting ink and forms an image on a print medium by scanning the print head in forward and backward directions different from an arranging direction of
15 the plurality of nozzles and wherein a speed of the scan and a distance from the nozzles to the print medium can be set in at least two stages respectively, said method for adjusting positions of ink dots
20 scans in the forward and backward directions, said method comprising the steps of:

forming a plurality of adjustment patterns by the print head, in a manner that an ink ejection timing between the forward and backward scans is shifted by a
25 predetermined interval, the ink ejection timing being a timing of ejecting ink from the plurality of nozzles;

entering an adjustment value for the ink ejection timing between the forward and backward scans, the adjustment value being determined from the plurality of adjustment patterns;

- 5 storing the entered adjustment value; and correcting the adjustment value according to a combination of the scan speed and the distance in performing a print operation.

10 11. A print position adjusting method as claimed in claim 10, wherein the print head has heating elements to generate thermal energy for causing film boiling in ink as an energy for ejecting ink from the nozzles.

15 12. A printing apparatus using a print head having an array of a plurality of print elements and forming an image on a print medium by scanning said print head in a direction different from an arranging direction of the plurality of print elements, wherein rasters
20 making up the image are divided into at least two raster groups according to a driving mode of the plurality of print elements, said apparatus comprising:

means for forming a plurality of adjustment
25 patterns by said print head, in a manner that a print element drive timing between the at least two raster groups is shifted a predetermined interval, said print

element drive timing being a timing of driving the plurality of print elements; and

means for storing an adjustment value for the print element drive timing between the at least two
5 raster groups, the adjustment value being supplied based on judgement of the plurality of adjustment patterns.

13. A printing apparatus as claimed in claim 12,
10 wherein said print head has at least two columns of print elements arranged side by side in the scan direction, the at least two columns of print elements are shifted from each other by an amount less than a pitch at which the print elements are arranged in the
15 column, and the at least two columns of print elements print the at least two raster groups.

14. A printing apparatus as claimed in claim 13,
wherein said print head has a nonvolatile memory in
20 which unique information on said print head is stored, the nonvolatile memory stores at least the adjustment value for adjusting the print positions, and said adjustment pattern forming means shifts the drive timing between the at least two columns of print
25 elements by the predetermined interval by taking the adjustment value stored in the nonvolatile memory as a reference to form the plurality of adjustment patterns.

005780" E426E960

15. A printing apparatus as claimed in claim 12,
further comprising means for scanning said print head
with respect to said print medium in a forward
5 direction and in a backward direction and for feeding
the print medium relative to the print head in a
direction perpendicular to the scan direction by a
distance required to print an image on said print
medium at a density higher than that in which the
10 plurality of print elements are arrayed, the relative
feeding of the print medium being performed between
the forward scan and the backward scan, the forward
scan and the backward scan being performed to print
the two raster groups.
- 15
16. A printing apparatus as claimed in claim 12,
wherein the adjustment patterns have a dot
distribution with a blue noise characteristic at a
resolution at which the printing apparatus can print.
- 20
17. A printing apparatus as claimed in claim 12,
wherein the adjustment patterns are digitized by a
conditional decision making method of a dithering
method at a resolution at which the printing apparatus
25 can print.
18. A printing apparatus as claimed in claim 12,

wherein said print head ejects ink to perform printing and the print elements have a nozzle for ejecting the ink.

5 19. A printing apparatus as claimed in claim 18, further comprising means for setting a speed of the scan and a distance from the nozzles to the print medium in at least two stages respectively and means for correcting the adjustment value according to a
10 combination of the scan speed and the distance.

20. A printing apparatus as claimed in claim 18, wherein the print head has heating elements to generate thermal energy for causing film boiling in
15 ink as an energy for ejecting ink from the nozzles.

21. A printing apparatus using a print head having an array of a plurality of nozzles for ejecting ink and forming an image on a print medium by scanning the
20 print head in forward and backward directions different from an arranging direction of the plurality of nozzles, wherein a speed of the scan and a distance from the nozzles to the print medium can be set in at least two stages respectively, said apparatus
25 comprising:

means for forming a plurality of adjustment patterns by the print head, in a manner that an ink

ejection timing between the forward and backward scans is shifted by a predetermined interval, the ink ejection timing being a timing of ejecting ink from the plurality of nozzles;

5 means for storing an adjustment value for the ink ejection timing between the forward and backward scans, the adjustment value being supplied based on judgement of the plurality of adjustment patterns; and

means for correcting the adjustment value
10 according to a combination of the scan speed and the distance in performing a print operation.

22. A printing apparatus as claimed in claim 21, wherein the print head has heating elements to
15 generate thermal energy for causing film boiling in ink as an energy for ejecting ink from the nozzles.

23. A printing system comprising:

a printing apparatus using a print head having an
20 array of a plurality of print elements and forming an image on a print medium by scanning said print head in a direction different from an arranging direction of the plurality of print elements, wherein rasters making up the image are divided into at least two
25 raster groups according to a driving mode of the plurality of print elements, said apparatus having:

means for forming a plurality of adjustment

005750" E4265560

patterns by said print head, in a manner that a print element drive timing between the at least two raster groups is shifted a predetermined interval, said print element drive timing being a timing of driving the
5 plurality of print elements; and

means for storing an adjustment value for the print element drive timing between the at least two raster groups, the adjustment value being supplied based on judgement of the plurality of adjustment
10 patterns; and

a host apparatus for supplying image data to said printing apparatus, having:

means for controlling said printing apparatus to form the plurality of adjustment patterns;

15 means for accepting entering of the adjustment value based on judgement of the plurality of adjustment patterns; and

means for supplying the adjustment data to said printing apparatus.

20

24. A printing system comprising:

a printing apparatus using a print head having an array of a plurality of nozzles for ejecting ink and forming an image on a print medium by scanning the

25 print head in forward and backward directions different from an arranging direction of the plurality of nozzles, wherein a speed of the scan and a distance

from the nozzles to the print medium can be set in at least two stages respectively, said apparatus having:

means for forming a plurality of adjustment patterns by the print head, in a manner that an ink
5 ejection timing between the forward and backward scans is shifted by a predetermined interval, the ink ejection timing being a timing of ejecting ink from the plurality of nozzles;

means for storing an adjustment value for the ink
10 ejection timing between the forward and backward scans, the adjustment value being supplied based on judgement of the plurality of adjustment patterns; and

means for correcting the adjustment value according to a combination of the scan speed and the
15 distance in performing a print operation; and

a host apparatus for supplying image data to said printing apparatus, having:

means for controlling said printing apparatus to form the plurality of adjustment patterns;

20 means for accepting entering of the adjustment value based on judgement of the plurality of adjustment patterns; and

means for supplying the adjustment data to said printing apparatus.

25

25. A storage medium storing a program for performing a print position adjusting method for a printing

00539743 081500

apparatus, wherein the printing apparatus uses a print head having an array of a plurality of print elements and forms an image on a print medium by scanning said print head in a direction different from an arranging
5 direction of the plurality of print elements and wherein rasters making up the image are divided into at least two raster groups according to a driving mode of the plurality of print elements, said method for adjusting print positions by the plurality of print
10 elements between the at least two raster groups, said method comprising the steps of:

forming a plurality of adjustment patterns by said print head, in a manner that a print element drive timing between the at least two raster groups is
15 shifted a predetermined interval, said print element drive timing being a timing of driving the plurality of print elements;

entering an adjustment value for the print element drive timing between the at least two raster
20 groups, the adjustment value being determined from the plurality of adjustment patterns; and

storing the entered adjustment value.

26. A storage medium storing a program for performing
25 a print position adjusting method for a printing apparatus, wherein the printing apparatus uses a print head having an array of a plurality of nozzles for

ejecting ink and forms an image on a print medium by scanning the print head in forward and backward directions different from an arranging direction of the plurality of nozzles and wherein a speed of the scan and a distance from the nozzles to the print medium can be set in at least two stages respectively, said method for adjusting positions of ink dots ejected from the plurality of nozzles between the scans in the forward and backward directions, said method comprising the steps of:

forming a plurality of adjustment patterns by the print head, in a manner that an ink ejection timing between the forward and backward scans is shifted by a predetermined interval, the ink ejection timing being a timing of ejecting ink from the plurality of nozzles;

entering an adjustment value for the ink ejection timing between the forward and backward scans, the adjustment value being determined from the plurality of adjustment patterns;

storing the entered adjustment value; and

correcting the adjustment value according to a combination of the scan speed and the distance in performing a print operation.

25

27. A print position adjusting method for adjusting a print position on a print medium during a forward scan

and a print position on the print medium during a backward scan in a printing apparatus, wherein said printing apparatus removably supports a print head on which a plurality of ink ejection openings are

- 5 arranged, and reciprocally scans said print head in a direction different from the arranging direction while ejecting ink to form an image, said method comprising the steps of:

referring first memory means in said printing
10 apparatus storing first print position information associated with characteristic variations of said printing apparatus and second memory means in said print head storing second print position information associated with characteristic variations of said
15 print head, before forming an image by mounting said print head on said printing apparatus; and

determining an adjustment value for adjusting the print position, based on said first and second print position information obtained by said referring.

20

28. A print position adjusting method as claimed in claim 27, wherein said first print position information includes information on a distance from a member for restricting a printing surface of the print
25 medium to the nozzles.

29. A print position adjusting method as claimed in

claim 27, wherein said second print position information includes information on an ejection speed of ink ejected from said print head.

- 5 30. A print position adjusting method as claimed in claim 27, wherein each of said first and second memory means has a form of nonvolatile memory.

- 10 31. A print position adjusting method as claimed in claim 27, wherein said print head has at least two columns of ejection openings arranged side by side in the scan direction, said at least two columns of ejection openings are shifted from each other by an amount less than a pitch at which the ejection
15 openings are arranged in the column.

32. A print position adjusting method as claimed in claim 27, wherein the print head has heating elements to generate thermal energy for causing film boiling in
20 ink as an energy for ejecting ink from ejection openings.

33. A print position adjusting method for adjusting a print position on a print medium during a forward scan
25 and a print position on the print medium during a backward scan in a printing apparatus, wherein said printing apparatus removably supports a print head on

which a plurality of ink ejection openings are arranged, and reciprocally scans said print head in a direction different from the arranging direction while ejecting ink to form an image, said method comprising
5 the steps of:

detecting a temperature of said print head;
estimating an ejection speed of ink ejected from said print head based on the detected temperature; and
determining an adjustment value for adjusting
10 said print positions based on the estimated ejection speed.

34. A print position adjusting method as claimed in claim 33, wherein said ejection speed is estimated
15 from information on the detected temperature and from information on the ejection speed characteristic of said print head and stored in memory means of said print head.

35. A print position adjusting method as claimed in claim 33, wherein said print head has at least two columns of ejection openings arranged side by side in the scan direction, said at least two columns of ejection openings are shifted from each other by an
20 amount less than a pitch at which the ejection openings are arranged in the column.
25

36. A print position adjusting method as claimed in claim 33, wherein the print head has heating elements to generate thermal energy for causing film boiling in ink as an energy for ejecting ink from ejection
5 openings.

37. A print position adjusting method for adjusting a print position on a print medium during a forward scan and a print position on the print medium during a
10 backward scan in a printing apparatus, wherein said printing apparatus removably supports a print head on which a plurality of ink ejection openings are arranged, and reciprocally scans said print head in a direction different from the arranging direction while
15 ejecting ink to form an image, said method comprising the steps of:

detecting a temperature of said print head;
switching a drive frequency and a scan speed of said print head based on the detected temperature;
20 estimating an ejection speed of ink ejected from said print head based on the detected temperature; and
determining an adjustment value for adjusting said print positions based on the estimated ejection speed and the scan speed.

25
38. A print position adjusting method as claimed in claim 37, wherein said ejection speed is estimated

from information on the detected temperature and from information on the ejection speed characteristic of said print head and stored in memory means of said print head.

5

39. A print position adjusting method as claimed in claim 37, wherein said print head has at least two columns of ejection openings arranged side by side in the scan direction, said at least two columns of
10 ejection openings are shifted from each other by an amount less than a pitch at which the ejection openings are arranged in the column.

40. A print position adjusting method as claimed in
15 claim 37, wherein the print head has heating elements to generate thermal energy for causing film boiling in ink as an energy for ejecting ink from ejection openings.

20 41. A printing apparatus removably supporting a print head on which a plurality of ink ejection openings are arranged, and reciprocally scanning said print head in a direction different from the arranging direction while ejecting ink to form an image, said apparatus
25 comprising:

first memory means for storing first print position information associated with characteristic

variations of said printing apparatus;

means for referring said first memory means and second memory means in said print head storing second print position information associated with

- 5 characteristic variations of said print head, before forming an image by mounting said print head on said printing apparatus; and

means for determining an adjustment value for adjusting a print position on a print medium during a
10 forward scan and a print position on the print medium during a backward scan, based on said first and second print position information obtained by said referring.

42. A printing apparatus as claimed in claim 41,
15 wherein said first print position information includes information on a distance from a member for restricting a printing surface of the print medium to the nozzles.

- 20 43. A printing apparatus as claimed in claim 41, wherein said second print position information includes information on an ejection speed of ink ejected from said print head.

- 25 44. A printing apparatus as claimed in claim 41, wherein each of said first and second memory means has a form of nonvolatile memory.

005750" 446960

45. A printing apparatus as claimed in claim 41,
wherein said print head has at least two columns of
ejection openings arranged side by side in the scan
5 direction, said at least two columns of ejection
openings are shifted from each other by an amount less
than a pitch at which the ejection openings are
arranged in the column.

10 46. A printing apparatus as claimed in claim 41,
wherein the print head has heating elements to
generate thermal energy for causing film boiling in
ink as an energy for ejecting ink from ejection
openings.

15 47. A printing apparatus removably supporting a print
head on which a plurality of ink ejection openings are
arranged, and reciprocally scanning said print head in
a direction different from the arranging direction
20 while ejecting ink to form an image, said apparatus
comprising:

means for detecting a temperature of said print
head;

25 means for estimating an ejection speed of ink
ejected from said print head based on the detected
temperature; and

means for determining an adjustment value for

adjusting a print position on a print medium during a forward scan and a print position on the print medium during a backward scan based on the estimated ejection speed.

5

48. A printing apparatus as claimed in claim 47, wherein said ejection speed is estimated from information on the detected temperature and from information on the ejection speed characteristic of
10 said print head and stored in memory means of said print head.

49. A printing apparatus as claimed in claim 47, wherein said print head has at least two columns of
15 ejection openings arranged side by side in the scan direction, said at least two columns of ejection openings are shifted from each other by an amount less than a pitch at which the ejection openings are arranged in the column.

20

50. A printing apparatus as claimed in claim 47, wherein the print head has heating elements to generate thermal energy for causing film boiling in ink as an energy for ejecting ink from ejection
25 openings.

51. A printing apparatus removably supporting a print

head on which a plurality of ink ejection openings are arranged, and reciprocally scanning said print head in a direction different from the arranging direction while ejecting ink to form an image, said apparatus comprising:

means for detecting a temperature of said print head;

means for switching a drive frequency and a scan speed of said print head based on the detected

temperature;

means for estimating an ejection speed of ink ejected from said print head based on the detected temperature; and

determining an adjustment value for adjusting a print position on a print medium during a forward scan and a print position on the print medium during a backward scan based on the estimated ejection speed and the scan speed.

52. A printing apparatus as claimed in claim 51, wherein said ejection speed is estimated from information on the detected temperature and from information on the ejection speed characteristic of said print head and stored in memory means of said print head.

53. A printing apparatus as claimed in claim 51,

wherein said print head has at least two columns of
ejection openings arranged side by side in the scan
direction, said at least two columns of ejection
openings are shifted from each other by an amount less
5 than a pitch at which the ejection openings are
arranged in the column.

54. A printing apparatus as claimed in claim 51,
wherein the print head has heating elements to
10 generate thermal energy for causing film boiling in
ink as an energy for ejecting ink from ejection
openings.

005730-061500